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PETITION FOR REGISTRATION OF UTILITY MODEL

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1 Title of the Contrivance

Cooling System for Linear Motor

2. Contriver

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5. List of Appended Documents

(1) Specification	1 set
(2) Drawing	1 copy
(3) Power of Attorney	1 copy

Examination for Formula: by Ogawa (Sealed)

SPECIFICATION

1. Title of the Contrivance

Cooling system for a linear motor

2. Claim

In a linear motor comprising an iron core having steel plates in a rectangle-shaped configuration put one on top of the other, and formed with slots in a comb-shaped configuration at predetermined intervals of place, a clamping means, windings contained in the slots, a cooling system for a liner motor, wherein parts of the slots of the iron core are provided with grooves having openings made in them, and a cooling tube in a folded configuration is inserted in the grooves.

3. Detailed Description of the Contrivance

This contrivance relates to a cooling system for a linear motor.

Figure 1 is a constructional view of a conventional linear motor. Figure 2 is a sectional view taken along the line II — II of Figure 1. Referring briefly to the linear motor shown in Figures 1 and 2, an iron core is depicted at 1.

In order to form this iron core 1, steel plates in a rectangular-shaped configuration which are longitudinally provided with a plurality of slots 2 at predetermined intervals of place are put one on top of the other. This iron core 1 is formed with a plurality of holes 3 for bolts fastening the iron core. Bolts 5 are passed through these holes 3 via a clamp 4 attached to both sides of the iron core 1, and the bolts 5 are mounted with nuts 6 at

their both ends. The nuts 6 are tightened to secure the iron core 1.

Windings 7 are contained in the slots 2, and a plurality of packings 8 are put in clearances created in the slots 2 as a result of the insertion of the packing into them. The windings 7 are fixed within the slots 2 by means of wedges 9.

The linear motor thus arranged is not provided with a rotor, and therefore, in this linear motor, it is impossible to attach any cooling fan to the stem of the rotor. This does not allow the linear motor to use any self-ventilation for its cooling. For this reason, in this linear motor, the cooling of the iron core 1 and the windings 7 depends solely upon the natural radiation of heat.

However, the natural radiation of heat is small in its heat diffusing effect, and therefore, in order to restrict an increase in the temperature of the linear motor to a certain limit, the structural members under a magnetic effect such as the iron core, the windings, and the like are required to be designed such that they are sufficiently great in their dimensions as compared with the capacity of the linear motor and also in comparison with the rotary motor.

Also, in the conventional linear motor, there are some component equipments which need to use forced cooling to inevitably limit an increase in their temperature from the viewpoints of their characteristics. Therefore, in order to cool, for example, the iron core, the windings, and the like, a cooling apparatus such as a fan provided separately from these component equipments is used to send air to them through ventilation flues

located around the component equipments. This is a disadvantage of the conventional linear motor.

In view of this disadvantage of the conventional linear motor, this contrivance is conducted to remove it. In this contrivance, the slots formed in the iron core are respectively provided in part with a groove which includes an opening, this groove has a folded tube inserted therein, and this folded tube is arranged to pass coolant therethrough, thereby allowing the iron core and the windings to be cooled. This provides a cooling system for a linear motor which is more efficient in its heat diffusing effect upon the linear motor.

Next, a preferred embodiment of the cooling system according to the present contrivance will now be described with reference to the accompanying drawings.

Figure 5 is a constructional view which explains a preferred embodiment of the cooling system according to the present contrivance. Also, Figure 4 is a sectional view taken along the line IV — IV of Figure 3. In these both Figures, the same portions as or the corresponding portions to those shown in Figures 1 and 2 are furnished with identical reference numerals.

An iron core is depicted at 1, and is formed by putting steel plates in a rectangular-shaped configuration one on top of the other.

As is apparent from Figure 5, this iron core 1 is longitudinally provided with slots 2' at predetermined intervals of place. The bottom portions of the slots 2' are respectively formed with a cooling groove 10

which is smaller in its width and height than the width a of the slot.

Figure 6 is an enlarged view which shows the slot 2' portion. As is apparent from this Figure 6 and Figure 4, the cooling grooves 10 have a cooling tube 11 inserted in them. This cooling tube 11 is bent in advance in a folded configuration so that it is adaptable for and into all the cooling grooves 10.

The both ends of the folded cooling tube 11 are fitted with pipe joints 12a and 12b.

The folded cooling tube 11 is contained in each groove 10 such that a bottom plate 13 (of the length l) of each slot 2' is brought into abutment with a reduced portion of the slot 2' over the overall length (l) thereof. (The reduced portion is formed by the width c and height c of the slot.)

As is apparent from Figure 7, the bottom plate 13 of the slot is bent in the direction which intersects at right angles with the longitudinal direction of the iron core, and the bent portions of both ends of the bottom plate 13 is formed with notched portions 14 in a semicircular configuration so that the outer circumferential surface of the folded cooling tube 11 rests upon the notched portions 14. The folded cooling tube 11 is fitted into the notched portions 14, thereby achieving the prevention of any detachment of the folded cooling tube 11 from the bottom plate 13 of the slot.

The clearance between the groove 10 and the folded cooling tube 11 at the lower portion of the slot has packing 15 inserted therein, which is high in its heat conductivity.

The arrangements of the other portions in the cooling system

according to the preferred embodiment of the present contrivance are the same as in the conventional cooling system, and therefore, their descriptions are omitted.

In the cooling system of this contrivance which is arranged as described in the foregoing, coolant (water or any other suitable coolant) is allowed to flow through the folded cooling tube 11, whereby the coolant absorbs the heat of the iron core 1 and that of the windings 7through the bottom plates 13 of the slots. A s a result, the iron core 1 and the windings 7 are allowed to decrease in their temperature. This achieves the same cooling effect as the provision of the air sending fan.

In the preferred embodiment of the present contrivance which is described in the foregoing, the folded cooling tube 11 is exemplified as a sectionally circular tube. As a matter of course, this cooling tube 11 may be in a square-shaped or other configuration in its section. In this case, it is self-evident that the notched portion 14 of the bottom plate of the groove of each slot may be formed in its configuration such as to be adaptable to the shape of the outer circumferential surface of the folded cooling tube 11. Also, although it is shown that the folded cooling tube 11 are disposed in the total of the slots 2', the cooling tube may be inserted in every other slot or at intervals of a predetermined number of slots.

Moreover, the location of each folded cooling tube is not limited to the bottom portion of the slot 2'. If the slots have opening located at their predetermined portions, the location of each folded cooling tube may be suitably changed from the shown location.

As described in the foregoing, according to the present contrivance, in a linear motor in which the iron core formed by putting steel plates in a rectangle-shaped configuration one on top of the other is longitudinally provided with the slots in a comb-shaped configuration at predetermined intervals of place, and are fastened by means of a clamping means, and the windings are contained in the slots, the folded cooling tube bent in advance in a zigzag-shaped configuration is inserted into each slot, and is arranged to allow coolant to flow through the cooling tube. This simpler construction improves the heat diffusing effects of the iron core and the windings, and allows the linear motor to enhance its operating efficiency. Also, for the coolant which is passed through the folded cooling tube, the factory water can be used, and this saves the cost for coolant feeding equipments, because the factory water equipments are suitably available in almost any manufacturing plants, and any additional high cost is not needed if the factory water equipments are employed to feed the factory water as coolant to the cooling tube. This also is an advantage of the cooling system for a linear motor according to the present contrivance in addition to the fact that there is no necessity of any superfluous equipments such as a cooling fan separately provided to send cooling air.

4. Brief Description of the Drawings

Figure 1 is a constructional view to explain a conventional linear motor. Figure 2 is a sectional view taken along the line II－II of Figure 1. Figure 3 is a frontal view which shows a single preferred embodiment of the cooling system for a linear motor according to the present contrivance.

Figure 4 is a sectional view taken along the line IV — IV of Figure 3. Figure 5 is a side view which shows an iron core of a liner motor to which the cooling system shown in Figure 3 in the foregoing is applied. Figure 6 is an enlarged view of a slot portion of the iron core depicted in Figure 5 in the foregoing. Figure 7 is a bottom plate of each slot which is applied to the cooling system shown in Figure 3 in the foregoing.

1 ...Iron core

2' ...Slot

4 ...Clamping means

5 ...Bolt

6 ...Nut

7 ...Winding

11 ...Folded cooling tube

13 ...Bottom plate of each slot

The same reference numerals in Figures show identical or corrresponding members or portions.

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